SUPRAPATELLAR APPROACH FOR INTRAMEDULARY TIBIAL NAILING IN SEMI EXTENDED POSITION OF KNEE JOINT-CASE SERIES STUDY

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MADRAS MEDICAL COLLEGE
INSTITUTE OF ORTHOPAEDICS AND TRAUMATOLOGY
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CERTIFICATE

This is to certify that this dissertation titled **SUPRAPATELLAR APPROACH FOR INTRAMEDULARY TIBIAL NAILING IN SEMI EXTENDED POSITION OF KNEE JOINT-CASE SERIES STUDY"** is a bonafide record of work done by **DR.R.SUDHAKAR.,** during the period of his Post graduate study from May 2015 to May 2018 under guidance and supervision in the INSTITUTE OF ORTHOPAEDICS AND TRAUMATOLOGY, Madras Medical College and Rajiv Gandhi Government General Hospital, Chennai-600003, in partial fulfilment of the requirement for **M.S.ORTHOPAEDIC SURGERY** degree Examination of The Tamilnadu Dr. M.G.R. Medical University to be held in April 2018.

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DECLARATION

I declare that the dissertation entitled **"SUPRAPATELLAR APPROACH FOR INTRAMEDULARY TIBIAL NAILING IN SEMI EXTENDED POSITION OF KNEE JOINT-CASE SERIES STUDY**" submitted by me for the degree of M.S is the record work carried out by me during the period of **June 2015 to September 2017** under the guidance of **PROF.A.PANDIASELVAN, M.S.ORTHO., D.Ortho.,** Professor of Orthopaedics, Institute of Orthopaedics and traumatology, Madras Medical College, Chennai. This dissertation is submitted to the Tamilnadu Dr.M.G.R. Medical University, Chennai, in partial fulfillment of the University regulations for the award of degree of M.S.ORTHOPAEDICS (BRANCH-II) examination to be held in April 2018.

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Place: Chennai
Date:

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INDEX

INTRODUCTION

Fractures of tibia and fibula shaft are the most common long bone fractures.In an average population more than 45 both bone leg fractures per one lakh population per year.Tibial fractures are associated with wide range of injury mechanism and severity.

The highest incidence of adult both bone leg fractures seen in young males is between 19 and 39 years of age.Compared to fractures elsewhere in the body,tibial fracture has relatively high incidence of nonunion and malunion.Tibial diaphysis is the most common site of fracture in the tibia and about 80% of these injuries are associated with fibular fractures .

Various treatment options are available for tibial shaft fractures dependimg upon the associated soft tissue injury.Severe open fractures of tibia are associated with high complication rates and poor long term outcomes..It is typically encountered in young patients and are a result of high energy trauma.

In surgical treatment intramedullary nail fixation remains the treatment of choice for displaced and undisplaced tibial shaft fractures in adult population.

Recent advance in nail design and reduction techniques have expanded the indications for intramedullary nail fixation to more proximal as well as more distal tibia fractures involving metaphyseal area .Establishing an anatomic starting point appears to be crucial in these fracture patterns .Suprapatellar nailing in the semi extended position has recently been suggested as a safe and effective surgical technique.This technique allows establishment of an appropriate starting point and semi extended position facilitates the fracture reduction of apex anterior deformity.

AIM AND OBJECTIVES

The aim is to study the clinical ,radiological and functional outcome and complication for tibial shaft fractures treated with intramedullary nailing through suprapatellar approach in semi extended position of knee at the Institute of orthopedics and traumatology ,Madras Medical College , Rajiv Gandhi Government General Hospital , Chennai , during the period of year October 2015 to October 2017.

REVIEW OF LITERATURE

Roy W. Sanders et al August 2014 studied semi extended intramedullary nailing of tibia using suprapatellar approach : Radiographical Results and Clinical Outcomes at a minimum of 12 month follow up, report that the procedure resulted in excellent tibial alignment ,union,knee range of movement with no apparent sequalae in the patellofemoral joint based on immediate arthroscopy and 1 year MRI scans.Even more interesting was the absence of anterior tibial pain typically found in upto 25%-60 % of cases where tibia nail is inserted in standard fashion.

Thirty six patients were available for followup at a minimum 1 year after the index procedure.All but two fractures healed after the index procedure there was one radiographic malunion.(2.7%)One patient complained of mild pain at the scar but no patient complained of anterior knee pain (2.7%).In 13 of 15 patients undergoing arthroscopic assessment of patellofemoral joint and pre-nail and post-nail insertion no cartilage changes.Two patients had Grade 2 chondromalacia of trochlea immediately after the procedure ,but these did not correspond with either MRI scans or clinical findings at one year.

Ole Brink et al 2016 studied 25 patients in suprapatellar nailing of tibial fractures : Surgical hints.At our instituition we have used the technique for 4 years with different system .In the beginning we used it for selected proximal fractures and later on distal tibial fractures and now also on shaft fractures.The technique also has been found to be useful in patient with multiple fractures such as ipsilateral femoral fractures,because all fractures can be operated without the need for manual traction or rearrangement.The method appears to be safe with no greater rate of complications compared with tradition methods .

Beigang Fu et al 2016 studied locked META intramedullary nailing fixation for tibial fractures via suprapatellar approach for 23 patients .The biggest advantage of suprapatellar approach was the extension of knee during the operation which was very useful in the treatment for complex metaphyseal and diaphyseal tibial fractures. In this study all 13 patients with tibial fractures of metaphyses, four cases of tibial multisegmental fractures and two cases of ipsilateral femoral fractures obtained satisfactory reduction and good recovery outcomes with no loss of reduction and aggravating displacement in the followup except for one case of proximal tibial fractures with 5 degree angulation

Sanders et al 2014 have initially reported the clinical and radiographic results of tibial fractures after suprapatellar intramedullary nailing found excellent tibial alignment ,union and range of motion of

knee joint.The study did not identify significant sequalae affecting the patellofemoral cartilage as per MRI arthroscopic evolution in particular it was not worthy that in their series did not identify any patient with postoperative knee pain at minimum 12 months of folloup.

Tylliankis et al 2000 have reported that IL nailing for tibial fracture was a reliable method characterized with high rates of union and low rates of postoperative complications

Tijs Jakma et al 2011, have studied insertion of intramedullary nails from suprapatellar pouch for proximal tibial shaft fractures .Intramedullary nailing of proximal tibial fractures can be difficult when using the standard entry portal.We performed suprapatellar nailing in 7 patients .Postoperative radiograph showed adequate position of nail and the screws in all patients . The nail was passing through the center of medullary canal .In 2nd patient there was a small gap in lateral view .Five patients have started weight bearing ,soft tissues are well healed in our first 5 patients with minimal cosmetic deficit from the procedure and good bone healing.

Morandi et al described a more lateral suprapatellar technique which the patella is sub luxated medially. The entry point of the nail is the safe zone of the tibia, described by Hernigou et al ,in both techniques.

Italo Scanavini Cerqueira 2011, anatomical study on the lateral suprapatellar assess route for locked intramedullary nails in tibial fractures.Intramedullary nails is currently considered to be the gold standard for treating tibial shaft fractures ,one most frequent complication that has to be combated is knee pain after the procedure. According to some authors chronic knee pain may affect more than 50% of the cases .In the present study we observed that it was very easy to locate the entry point through this route , even without using radioscopy. Positioning the guide wire totally blindly only injured the Hoffa fat in most cases.

Keating et al 2011, demonstrated that there is a high correlation between the transtendon route and anterior knee pain .

Boris A. Zelle et al 2015, have studied advance in intramedullary nailing : Suprapatellar nailing of tibial shaft fractures in semi extended position to facilitate achieving and maintaining fracture reduction particularily in proximal 3rd tibia fractures , reduce incidence of postoperative anterior knee pain .Satisfactory outcomes and reproducible results can be achieved with intramedullary nail fixation of tibial shaft fractures, union rate is above 90%.

Trevor Banka et al 2010, have studied intramedullary nailing of tibial fractures : Review of surgical techniques and description of a percutaneous lateral suprapatellar approach .We considered it as an

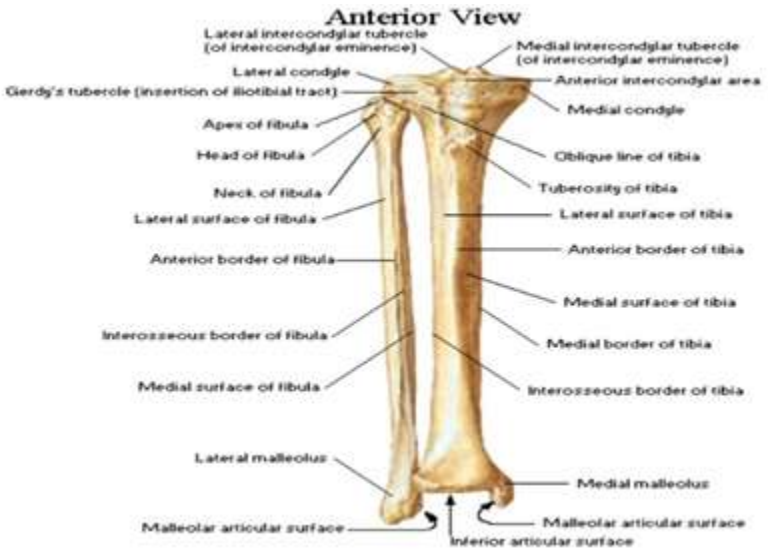
excellent approach for easy stabilization and fixation of proximal tibia fractures .There is no need for fracture table or bulky ,expensive surgical aids to prevent malalignment

The use of poller screws can be further more eliminated .The approach must be combined with the nail set that includes particular requirements ,specifically appropriately targeting and measuring device .The association of transverse small skin incision and avoidance of direct contact with patellar tendon made this surgical approach particularily prone to early mobilization of knee joint and is well tolerated by athletes or patient who kneel frequently.

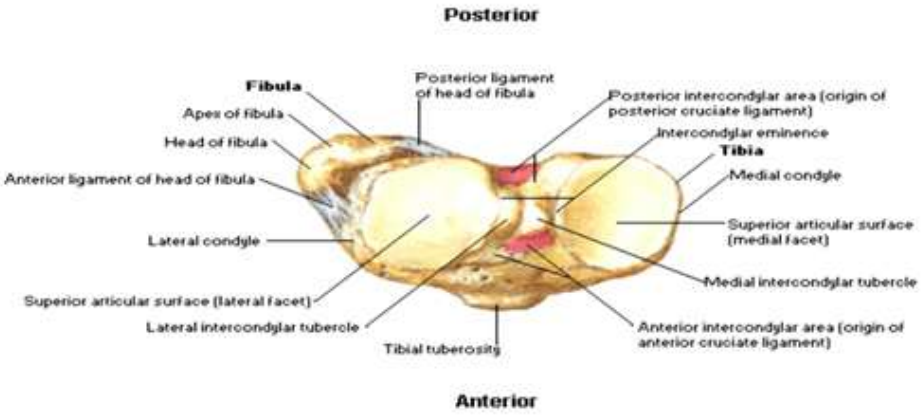
APPLIED ANATOMY

OSTEOLOGY

Tibia is a long tubular bone with a triangular cross section in medial side of the leg.The upper end can differ from lower end as it is much larger .The medial and lateral side of the bone can be distinguished by examining the lower end, this end has prominent downward projection, the medial malleolus on its medial side.The anterior and posterior aspects can be distinguished by examining the shaft, has a sharp anterior border. The upper part and medial and lateral condyle are separated by intracondylar area..The anterior aspect of upper end of tibia is marked by another projection called tibial tuberosity.



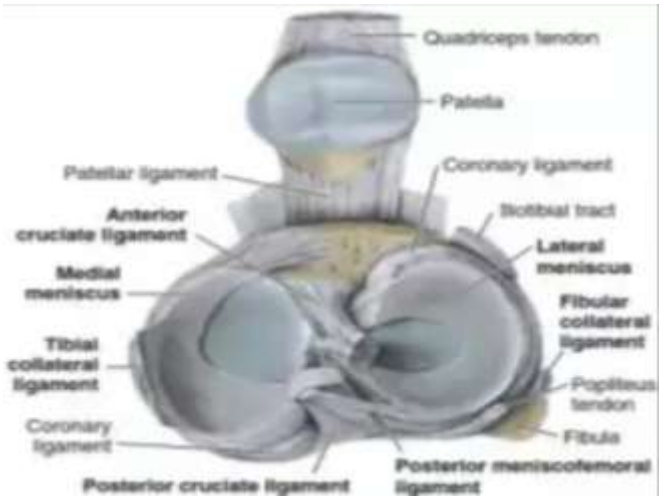
Upper surface of medial and lateral condyles bear large ,slightly concave, articular surface that take part in forming the knee joint.



The medial articular surface is oval and is larger than lateral surface which is rounded, the articular surfaces are separated by intercondylar area which is non articular. The intercondylar area is raised in its central part to form the intercondylar eminence.The medial and lateral parts of the eminence are more prominent than its central parts and constitute the medial and lateral intracondylar tubercles.

The medial and lateral condylar articular surfaces extend onto the sides of the intercondylar tubercles.

The anterior surfaces of medial and lateral condyles merge to form a large rough triangular area.The apex of the triangle is placed inferiorly and is placed to form a large projection called the tibial tuberosity



VASCULARITY

The nutrient artery arises from the posterior tibial artery,it's the largest nutrient artery in the body.It enters the posterolateral cortex distal to the origin of soleus muscle.Once the vessel enters the intramedullary canal it gives off 3 ascending branch and one descending branch.These gives rise to the endosteal vascular tree, which anastamose with periosteal vessel arising from the anterior tibial artery.

The anterior tibial artery is particularily vulnerable to injury as it passes through a hiatus in the intraosseous membrane. The peroneal

artery has an anterior communicating branch of dorsalis pedis artery.It may therefore be occluded despite an intact dorsalis pedis pulse.

The distal 3rd is supplied by periosteal anastomoses around the ankle which branches enters the tibia through ligamentous attachments .There may be a watershed area at the junction of the middle and distal thirds.

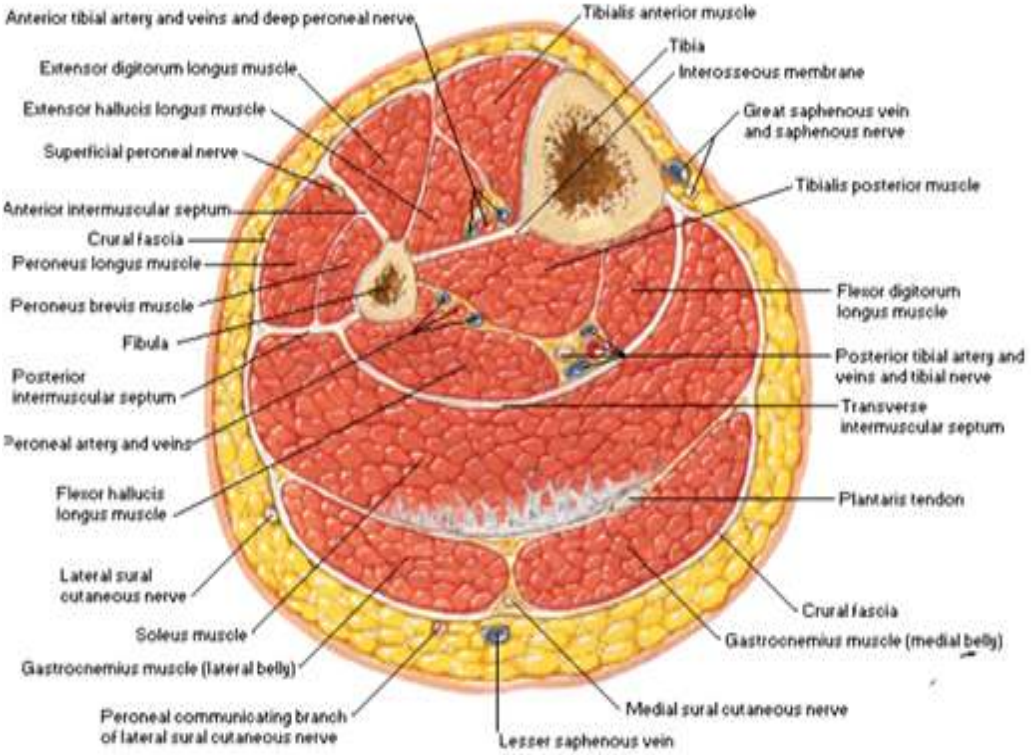
If the nutrient artery is disrupted there is reversible flow through the cortex and the periosteal blood supply becomes more important. This emphasizes the importance for preserving periosteal attachments during fixation

COMPARTMENTS AND MUSCULATURES

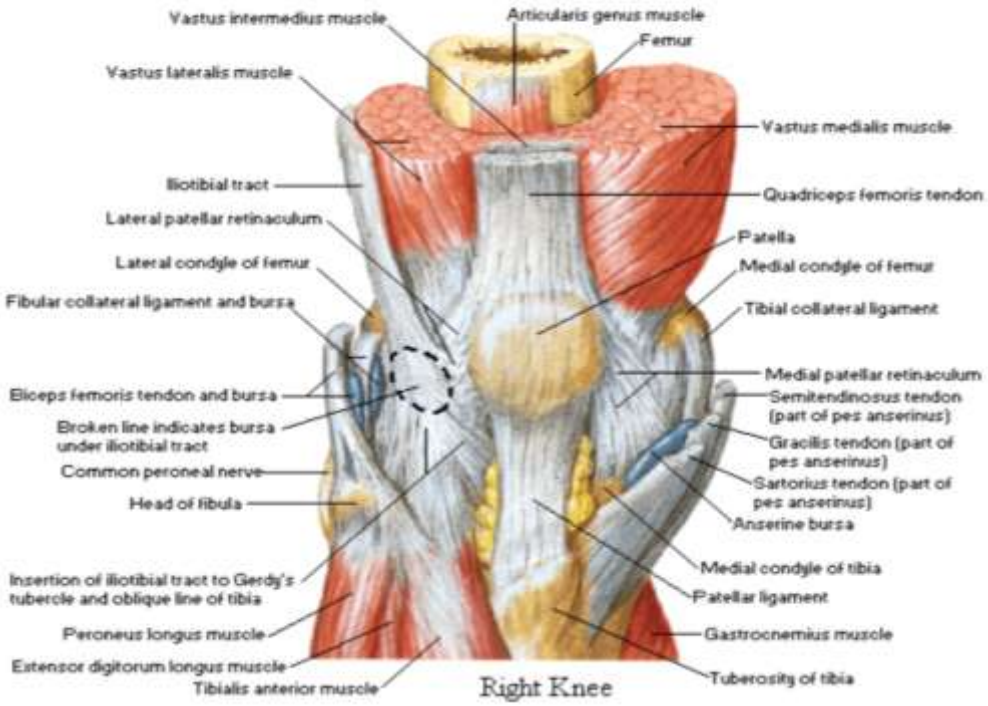
The 4 compartments of the leg with the muscles and nerves contained within them.

Compartment	Muscles	Nerves
Anterior	Tibialis anterior Extensor hallucis longus Extensor digitorum longus Peroneus tertius	Deep peroneal nerve
Lateral	Peroneus longus peroneus brevis	Superficial peroneal nerve
Superficial posterior	Gastrocnemius Soleus Plantaris	Tibial nerve
Deep posterior	Tibialis posterior Flexor hallucis longus Flexor digitorum longus Popliteus	Tibial nerve

Cross Section just above Middle of Left Leg



Anterior View



Right Knee

MECHANISM OF INJURY

Tibial fractures have a bimodal distribution with low energy spiral pattern being more common in patients over 50 years of age and high energy transverse and comminuted being more common in patients under 30 years of age.

However high energy tibial fracture in younger patients are approximately twice as common in males than females High energy tibial diaphyseal fractures are commonly associated with vehicular trauma.

GUSTILO AND ANDERSON CLASSIFICATION

This was originally designed to classify soft tissue injuries associated with open tibial shaft fractures and was later extended to all open fractures.

It is quantitative rather than qualitative.

Type	Size	Contamination level	Soft tissue injury	Bone injury
I	<1cm	clean	Minimal	Simple minimal comminution
II	>1cm	Moderate	Moderate,some muscle damage	Moderate comminution
III. A	>10cm	High	Severe with crushing	Usually comminuted,soft tissue coverage adequate
B	>10cm	High	Very sever loss of coverage,require reconstructive surgery	Bone coverage poor
C	>10cm	High	+vascular injury requiring repair	+moderate to severe comminution

AO CLASSIFICATION OF TIBIAL DIAPHYSEAL FRACTURE

Type A :Unifocal fracture

GROUP A1		**SPIRAL FRACTURES**
Subgroups	A1.1	Intact fibula
	A1.2	Tibia and fibula fractures at different level
	A1.3	Tibia and fibula fractures at same level
GROUP A2		**OBLIQUE FRACTURES (Fracture line >30 degree)**
Subgroups	A2.1	Intact fibula
	A2.2	Tibia and fibula fractures at different level
	A2.3	Tibia and fibula fractures at same level
GROUP A3		**TRANSVERSE FRACTURES Fracture line <30 degree)**
Subgroups	A3.1	Intact fibula
	A3.2	Tibia and fibula fractures at different level
	A3.3	Tibia and fibula fractures at same level

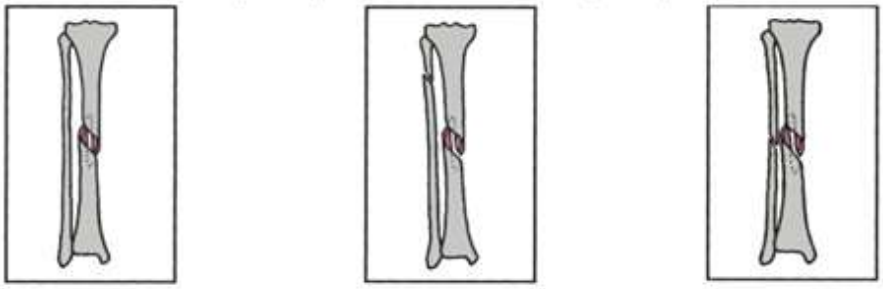
Subgroups and qualifications:

Tibia/fibula, diaphyseal, simple, spiral (42-A1)

(1) proximal zone
(2) middle zone
(3) distal zone

1. Fibula intact (42-A1.1)
2. Fibula fracture at different level (42-A1.2)
3. Fibula fracture at same level (42-A1.3)

A1

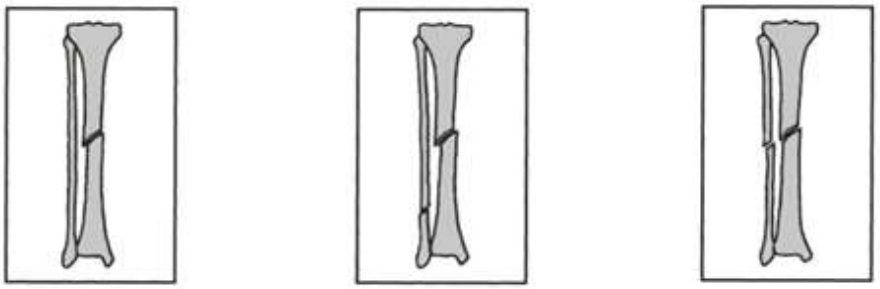


Tibia/fibula, diaphyseal, simple, oblique (>30 degrees) (42-A2)

(1) proximal zone
(2) middle zone
(3) distal zone

1. Fibula intact (42-A2.1)
2. Fibula fracture at different level (42-A2.2)
3. Fibula fracture at same level (42-A2.3)

A2



Tibia/fibula, diaphyseal, simple, transverse (<30 degrees) (42-A3)

(1) proximal zone
(2) middle zone
(3) distal zone

1. Fibula intact (42-A3.1)
2. Fibula fracture at different level (42-A3.2)
3. Fibula fracture at same level (42-A3.3)

A3

TYPE B: Wedge Fractures

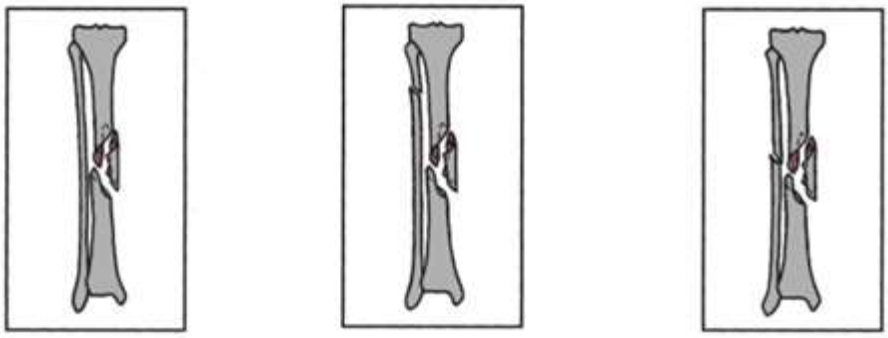
GROUP B1		**INTACT SPIRAL WEDGE FRACTRE**
Subgroups	B1.1	Intact fibula
	B1.2	Tibia and fibula fractures at different level
	B1.3	Tibia and fibula fractures at same level
GROUP B2		**INTACT BENDING WEDGE FRACTURE**
Subgroups	B2.1	Intact fibula
	B2.2	Tibia and fibula fractures at different level
	B2.3	Tibia and fibula fractures at same level
GROUP B3		**COMMINUTED WEDGE FRACTURE**
Subgroups	B3.1	Intact fibula
	B3.2	Tibia and fibula fractures at different level
	B3.3	Tibia and fibula fractures at same level

Tibia/fibula, diaphyseal, wedge, spiral (42-B1)

(1) proximal zone
(2) middle zone
(3) distal zone

1. Fibula intact (42-B1.1)
2. Fibula fracture at different level (42-B1.2)
3. Fibula fracture at same level (42-B1.3)

B1

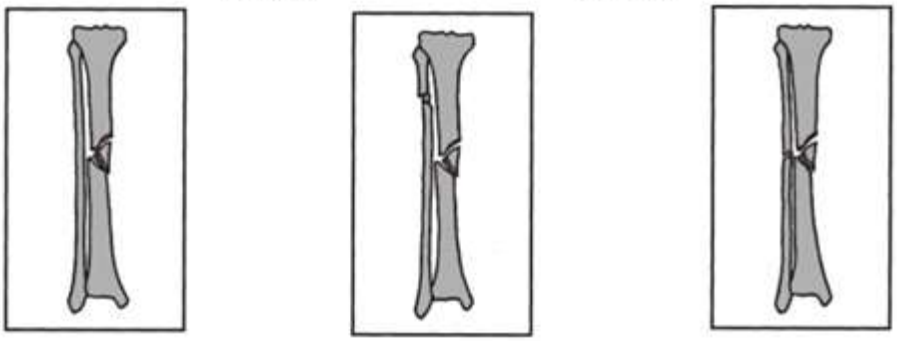


Tibia/fibula, diaphyseal, wedge, bending (42-B2)

(1) proximal zone
(2) middle zone
(3) distal zone

1. Fibula intact (42-B2.1)
2. Fibula fracture at different level (42-B2.2)
3. Fibula fracture at same level (42-B2.3)

B2

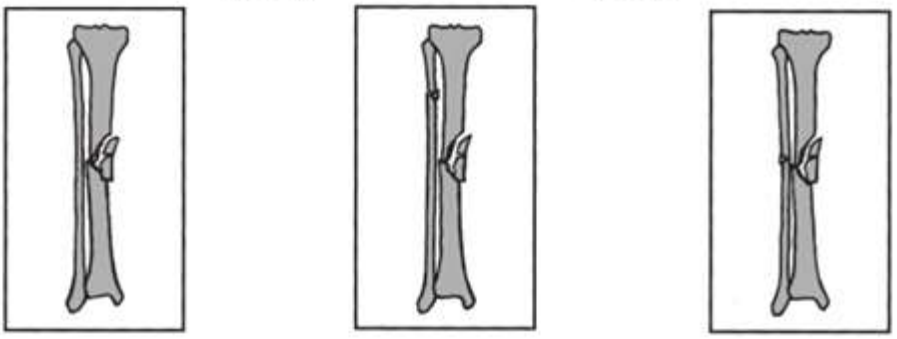


Tibia/fibula, diaphyseal, wedge fragmented (42-B3)

(1) proximal zone
(2) middle zone
(3) distal zone

1. Fibula intact (42-B3.1)
2. Fibula fracture at different level (42-B3.2)
3. Fibula fracture at same level (42-B3.3)

B3



TYPE C:Complex Fracture (Multisegmentary,Segmental or Comminuted Fracture)

Group C1		**SPIRAL WEDGE FRACTRE**
Subgroups	C1.1	Two intermediate fragments
	C1.2	Three intermediate fragments
	C1.3	More than three intermediate fragments
Group C2		**SEGMENTAL FRACTURE**
Subgroups	C2.1	One segmental fragment
	C2.2	Segmental fragment and additional wedge fragment
	C2.3	Two segmental fragments
Group C3		**COMMINUTED FRACTURE**
Subgroups	C3.1	Two or three intermediate fragments
	C3.2	Limited comminution(<4cm)
	C3.3	Extensive comminution(>4cm)

Tibia/fibula, diaphyseal, complex, spiral (42-C1)

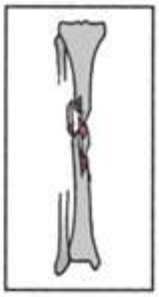
(1) pure diaphyseal
(2) proximal diaphysio-metaphysis
(3) distal diaphysio-metaphysis

1. With two intermediate fragments (42-C1.1)

2. With three intermediate fragments (42-C1.2)

3. With more than three intermediate fragments (42-C1.3)

C1



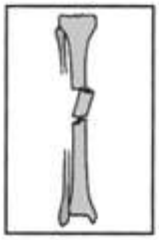
Tibia/fibula, diaphyseal, complex segmental (42-C2)

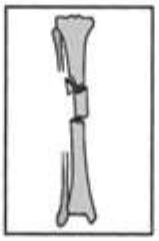
1. With an intermediate segmental fragment (42-C2.1)
(1) pure diaphyseal
(2) proximal diaphysio-metaphyseal
(3) distal diaphysio-metaphyseal
(4) oblique lines
(5) transverse and oblique lines

2. With an intermediate segmental and additional wedge fragment(s) (42-C2.2)
(1) pure diaphyseal
(2) proximal diaphysio-metaphyseal
(3) distal diaphysio-metaphyseal
(4) distal wedge
(5) Three wedges, proximal and distal

3. With 2 intermediate segmental fragments (42-C2.3)
(1) pure diaphyseal
(2) proximal diaphysio-metaphyseal
(3) distal diaphysio-metaphyseal

C2





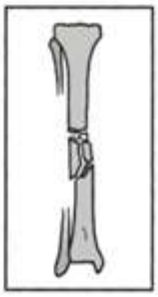
Tibia/fibula, diaphyseal, complex, irregular (42-C3)

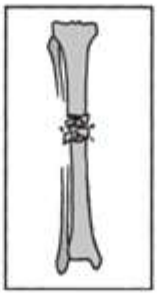
1. With two or three intermediate fragments (42-C3.1)
(1) Two intermediate fragments
(2) Three intermediate fragments

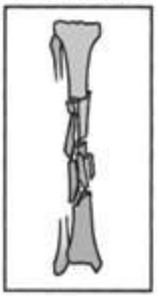
2. Limited shattering (> 4 cm) (42-C3.2)

3. Extensive shattering (> 4 cm) (42-C3.3)
(1) pure diaphyseal
(2) proximal diaphysio-metaphyseal
(3) distal diaphysio-metaphyseal

C3







TSCHERNE CLASSIFICATION OF OPEN FRACTURES

This takes into account wound size ,level of contamination and fracture mechanism

GRADE 1: Small puncture wound without associated contusion,negligible bacterial contamination,low energy mechanism of fracture

GRADE 2: Small laceration , skin and soft tissue contusion, moderate bacterial contamination,variable mechanism of injury.

GRADE 3: Large laceration with heavy bacterial contamination ,extendive soft tissue damage with frequent associated arterial or neural damage.

GRADE 4: Incomplete or complete amputation with variable prognosis based on location and nature of injury.

TSCHERNE CLASSIFICATION OF CLOSED FRACTURES

This classifies soft tissue injury in closed fractures and takes into account indirect vs direct injury mechanism

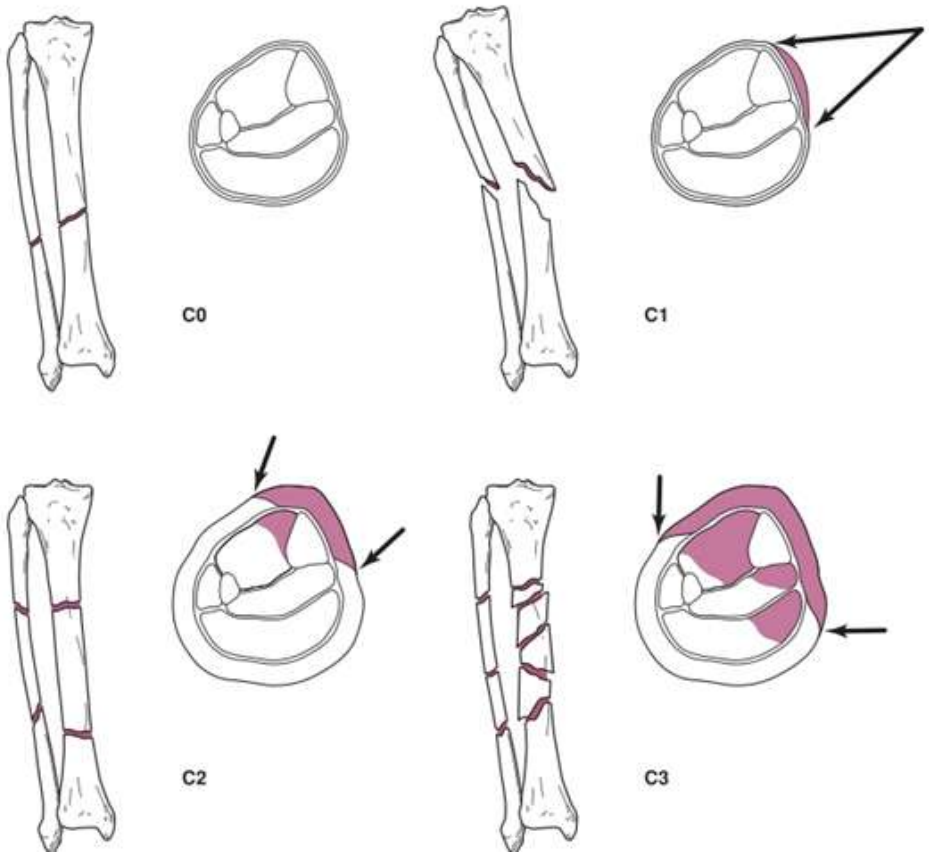
GRADE 0: Injury from indirect forces with negligible soft tissue damage

GRADE 1: Closed fracture caused bylow to moderate energy mechanisms.with superficial abrasions or contusions of soft tissues overlying the fracture

GRADE 2: Closed fracture with significant muscle contusion with possible deep contaminated skin abrasion associated with moderate to severe energy mechanism,high risk for compartment syndrome

GRADE 3: Extensive crushing of soft tissue with subcutaneous degloving or avulsion ,and arterial disruption or established compartment syndrome

TSCHERNE CLASSIFICATION OF CLOSED FRACTURES IMAGES



COMMONLY ASSOCIATED INJURIES

- Compartment syndrome
- Ankle injuries – Lateral ligamentous complex disruption fracture of lateral ,posterior and medial malleoli.
- Floating Knee Injuries – with intra articular involvement of knee.
- Fracture extension to tibial plateau

- Knee ligamentous injury

- Proximal tibiofibular joint dislocation – lateral ligamentous instability and peroneal nerve injury.

CLINICAL FEATURES

Signs and Symptoms of Tibial Shaft Fracture

Symptoms **–** Pain and difficulty in movements, soft tissue injury, swelling.

Signs **–** Patient assessment involves airway, breathing, circulation, disability and exposure.Tenderness over the injury site, abnormal mobility, crepitus, distal pulse, neurological evolution.

DIAGNOSIS

The fracture shaft of tibia diagnosed by clinical diagnosis and radiological diagnosis

1) CLINICAL DIAGNOSIS

- Pain is the most evident and commonest symptom, with pain on movements
- Tenderness , crepitus, abnormal mobility, shortening ,soft tissue injury level.

2)RADIOLOGICAL DIAGNOSIS

- An anteroposterior view of injured leg with one joint above and one below
- A lateral view of injured leg with one joint above and one below
- If suspicious intra articular involvement is present, take the CT Scan of the corresponding joint.

TREATMENT

NON OPERATIVE

Fracture reduction followed by application of long cast with progressive weight bearing can be used for isolated ,closed ,low energy fractures with minimal displacement and comminution.

Cast with the knee in 0 – 5 degree of flexion to allow for weight bearing with crutches as soon as tolerated by the patient with advancement of full weight bearing by 2-4 th week.After 3-6 weeks the long leg cast may be exchanged for a patellar bearing cast or fracture brace

ACCEPTABLE FRACTURE REDUCTION CRITERIA

- <5 degree varus\valgus accepted
- <10 degree anterior\posterior angulation accepted
- <10 degree of rotational deformity
- <1 cm of shortening accepted
- >50% cortical contact is recommended

PREOPERATIVE MEASURES

1) The main preoperative planning step is unique to the tibial nailing is determining whether the fracture pattern is amenable to fixation with a nail.

2) Ensuring the canal is not too small for the size of nail available.

3) *To* rule out preexisting knee stiffness obliterated medullary canal.

4) Adequate preoperative radiological imaging .

OPERATIVE MEASURES

Indications

- Inadequate alignment ,length and the rotation after application of splint or cast
- Open fracture
- Arterial injury
- Displaced proximal or distal fractures
- Segmental fracture
- Ipsilateral femoral fracture
- Comminuted fractures

SURGICAL APPROACHES

- Medial Parapatellar
- Lateral parapatellar
- Patellar tendon split approach
- Suprapatellar approach

MEDIAL PARAPATELLAR APPROACH

Incision typically centered over the knee, or 1cm medial for medial parapatellar approach,starting from midpoint of patella and runs distally about the same length as the patella. The dissection is continued to identify the medial border of patella and a longitudinal incision is made along the course. The approach should not go into the knee joint but rather remain in the fat pad.

The typical difficulty with medial parapatellar approach is obtaining a starting point that is sufficiently lateral as the patella and patellar tendon tend to push the starting wire too medial.

PATELLAR TENDON SPLIT APPROACH

An approach that eliminates the difficulty of placing the guide wire for enough lateral with medial parapatellar tendon approach is the patellar tendon split.The incision is brought down to the tendon and a longitudinal split is made into the tendon.Care is taken to protect the tendon at all times during the surgery.

This patellar tendon split approach does present some difficulty in obtaining the ideal starting angle that is most important in proximal tibial fractures as it is not possible to sublux the patella away from the starting wire as the wire is passing through the patellar tendon. This can make the starting wire tend to angle posteriorly. This is of less consequence in the distal fractures.

SUPRAPATELLAR APPROACH

Position Of Patient

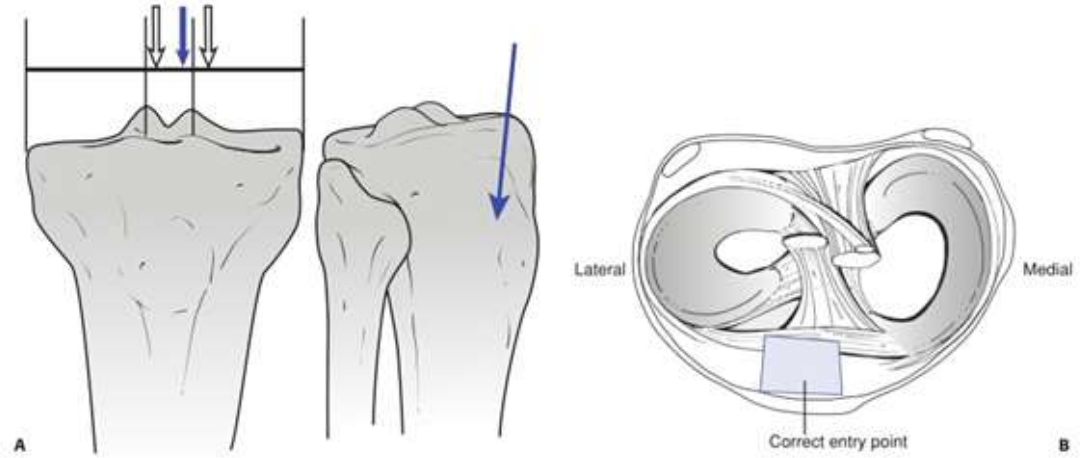
The patient is placed supine with bump under the ipsilateral hip to help prevent natural tendency of the limb to externally rotate at the hip.The bolster under the knee joint which is bent 20-30 degree. Fluoroscopy is placed on the contralateral side of the patients injured limb.

Images shows position of limb and skin incision

INCISION AND THE ENTRY POINT

The incision is made more proximally than for the other starting points beginning at the superior pole of patella and proceeding 5cm proximally .The quadriceps tendon is split longitudinally and the knee joint is entered from above .

The ideal starting point is just medial to lateral tibial spine.The ideal entry point seen on anteroposterior view is located 9mm lateral to the center of the tibia plateau and slightly lateral to tibial tubercle.On the lateral view the entry point is anterior to the articular margin.



Images shows ideal entry point in AP and Lateral View and Superior View

Insertion Of Guide Wire

There after using the surgeons index finger or a blunt periosteal dissector the patellofemoral joint is entered directly under the proximal pole patella.If the patella is easily maneuvered guiding the index finger ,the canula is then inserted.The canula and the trocar are then inserted into the knee with the canula sliding down the trochlear groove ,until it comes into contact with the anterior tibia at the junction of anterior cortex and the articular surface.

The blunt trocar is then exchanged for a multiholed guide pin sleeve. A 3.2mm guide pin is placed into the central hole and drilled into the tibia just until minimal purchase is achieved

AP followed Lateral Fluoroscopy view is then obtained to determine the position of guide pin , the appropriate position should be medial to lateral tibial spine and in line with Tibial shaft on the AP view at junction of anterior cortex and the articular surface on the lateral fluoroscopic view .The pin is simply a point of purchase it should not be drilled in farther than 3-5cm.

Images shows C-arm AP and Lateral View

PROCEDURE OF REAMING

Once the guide pin position has been accepted the multiholed sleeve is removed and an entry reamer is introduced through the canula

to open the canal.As started previously the surgeon should direct the reamer to assure proper placement .

Image shows C-arm reaming during procedure

The reamer should not be introduced across the fracture unless the fracture is reduced.If the reduction is required then the reamer is removed and reduction tool is inserted through the canula to reduce the fracture.Because the leg is essential flat than the operative table,gravity is not an issue,the fracture can be easily reduced by assistant while reduction tool is used.

If the fracture is highly comminuted ,reduction forceps, clamps, blocking screw can be used to assist the reduction.Once the fracture is reduced straight guide wire is placed.

PLACEMENT OF NAIL

Intramedullary reaming done by various sizes of reamers.Nail diameter is determined with reamer size 1-2mm less than that of reamer then properly selected nail is inserted .Both AP and lateral alignment should be monitored, nail passes through the fracture and distal positioning and proximal seating all are best seen in lateral fluoroscopy view,which can be easily be obtained due to the fact leg is in extension.

Proximal locking screws are inserted followed by Distal interlocks, If compression of fracture is desired distal locking is performed first under fluoroscopic guidance.

Image shows complete nail and screw insertion

After final fluoroscopic views are obtained ,the cannula is removed ,and the knee is washed with saline. A full range of movements should be applied to the knee for verification of patellar tracking and the wounds are closed in layered manner .

SURGICAL HINTS IN SUPRAPATELLAR APPROACH FOR INTRAMEDULLARY TIBIAL NAILING IN SEMIEXTENDED POSITION OF KNEE

Position of patient - supine 20 degree knee flexion

↓

Incision – midline at the superior pole of patella

↓

Longitudinal split of Quadriceps tendon

↓

Knee joint entered from above

↓

Custom made trocar and protective sleeve inserted

↓

Entry points just medial to the lateral tibial spine

↓

Guide wire insertion

↓

Serial Reaming

↓

Fracture reduction

↓

Confirmed by fluoroscopy

↓

Placement of appropriate size of nail

↓

Insertion of proximal screw with custom made proximal jig

↓

Insertion of distal screw by free hand technique under fluoroscopy

↓

Wash and closure of sutures

PEROPERATIVE POSTION OF PATIENT

Picture showing patient in supine postion with knee 20 degree flexion – semiextended position

Picture showing incision over the midline at the superior pole of patella

PEROPERATIVE TECHNIQUE

Picture showing Quadriceps tendon on longitudinal split

Insertion of custom made trocar and protective sleeve

PEROPERATIVE FLUOROSCOPIC IMAGES

Anteroposterior view of entry point

Lateral view of entry point

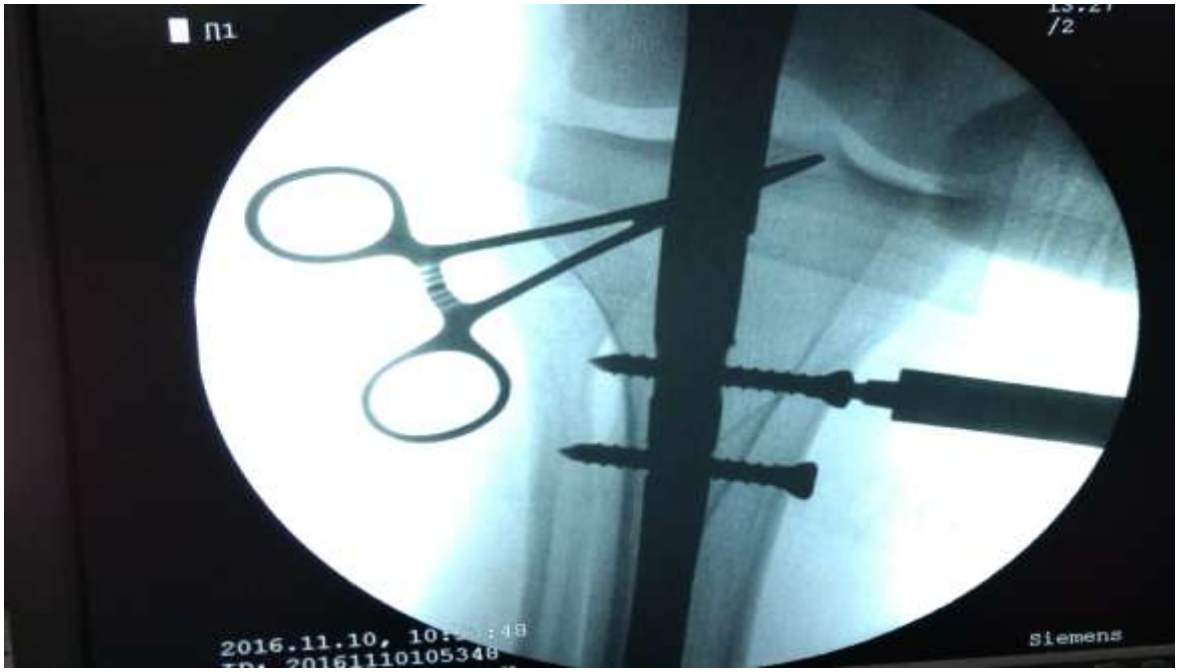
PEROPERATIVE TECHNIQUE

Picture showing reaming of medullary canal

Picture showing insertion of nail with custom made proximal jig

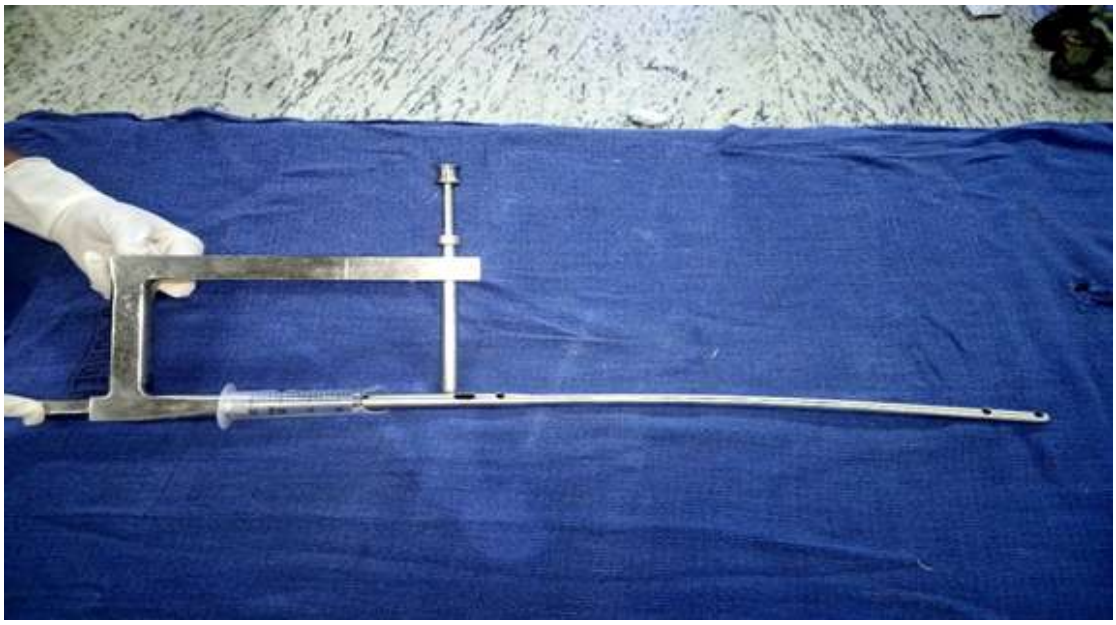
PEROPERATIVE TECHNIQUE

Picture showing nail insertion with custom made proximal jig



Picture showing screw insertion .

INSTRUMENTATION KIT



CUSTOM MADE PROXIMAL JIG WITH PROTECTIVE SLEEVE WITH TIBIA NAIL SURGICAL COMPLICATIONS

IMMEDIATE COMPLICATIONS

- Infection
- Haemarthrosis
- Ligamentous Injury – Lateral meniscus and anterior cruciate ligament
- Knee stiffness
- Patellar and Trochlear cartilage injury

LATE COMPLICATIONS

- Non union
- Malunion
- Implant failure
- Osteoarthritis of knee joint
- Chondromalacia of patella

POST OPERATIVE PROTOCOL AND FOLLOW UPS

- Exercise to encourage the knee and ankle range of motion should be initiated as soon as possible

- Suture removal on the 2nd week.

- Weight bearing is determined by the axial stability of fracture pattern.if there is good axial stability as seen in non comminuted diaphyseal fracture pattern then immediate weight bearing as tolerated is usually instituted.

- Non weight bearing with crutches or walker for atleast 6 weeks after discharge for highly comminuted fracture pattern

- Partial weight bearing till radiological union

- Patients were followed at 1,2,3,6 and 12 months after surgery.AP and lateral X ray films are taken at each follow up for evaluations of fracture healing,implant position and the general condition of the fracture site.

THE LOWER EXTREMITY FUNCTIONAL SCALE

This scoring system is investigated under various daily activity performance such as house work ,sports activity ,outing shoes ,squatting ,running even ground and uneven ground etc..The maximum score is 80 for 20 related daily activities .Each activity got maximum 4 scores

- Score between 70-80 indicate excellent functional outcome
- Score between 60-70 indicate good functional outcome
- Score between 40-60 indicates fair functional outcome
- Score <40 indicates poor functional outcome

The Lower Extremity Functional Scale

We are interested in knowing whether you are having any difficulty at all with the activities listed below **because of your lower limb problem** for which you are currently seeking attention. Please provide an answer for **each** activity.

Today, *do you* or *would you* have any difficulty at all with:

	Activities	Extreme Difficulty or Unable to Perform Activity	Quite a Bit of Difficulty	Moderate Difficulty	A Little Bit of Difficulty	No Difficulty
1	Any of your usual work, housework, or school activities.	0 ☐	1 ☐	2 ☐	3 ☐	4 ☐
2	Your usual hobbies, re creational or sporting activities.	0 ☐	1 ☐	2 ☐	3 ☐	4 ☐
3	Getting into or out of the bath.	0 ☐	1 ☐	2 ☐	3 ☐	4 ☐
4	Walking between rooms.	0 ☐	1 ☐	2 ☐	3 ☐	4 ☐
5	Putting on your shoes or socks.	0 ☐	1 ☐	2 ☐	3 ☐	4 ☐
6	Squatting.	0 ☐	1 ☐	2 ☐	3 ☐	4 ☐
7	Lifting an object, like a bag of groceries from the floor.	0 ☐	1 ☐	2 ☐	3 ☐	4 ☐
8	Performing light activities around your home.	0 ☐	1 ☐	2 ☐	3 ☐	4 ☐
9	Performing heavy activities around your home.	0 ☐	1 ☐	2 ☐	3 ☐	4 ☐
10	Getting into or out of a car.	0 ☐	1 ☐	2 ☐	3 ☐	4 ☐
11	Walking 2 blocks.	0 ☐	1 ☐	2 ☐	3 ☐	4 ☐
12	Walking a mile.	0 ☐	1 ☐	2 ☐	3 ☐	4 ☐
13	Going up or down 10 stairs (about 1 flight of stairs).	0 ☐	1 ☐	2 ☐	3 ☐	4 ☐
14	Standing for 1 hour.	0 ☐	1 ☐	2 ☐	3 ☐	4 ☐
15	Sitting for 1 hour.	0 ☐	1 ☐	2 ☐	3 ☐	4 ☐
16	Running on even ground.	0 ☐	1 ☐	2 ☐	3 ☐	4 ☐
17	Running on uneven ground.	0 ☐	1 ☐	2 ☐	3 ☐	4 ☐
18	Making sharp turns while running fast.	0 ☐	1 ☐	2 ☐	3 ☐	4 ☐
19	Hopping.	0 ☐	1 ☐	2 ☐	3 ☐	4 ☐
20	Rolling over in bed.	0 ☐	1 ☐	2 ☐	3 ☐	4 ☐
	Column Totals:					

Minimum Level of Detectable Change (90% Confidence): 9 points **SCORE: _____/ 80 (fill in the blank with the sum of your responses)**

METHODS AND MATERIALS

This is a prospective study for the study of the clinical ,radiological and functional outcome and complication for tibial shaft fractures treated with intramedullary nailing through suprapatellar approach in semi extended position of knee

in 20 patients in the period of ***October 2015 to October 2017*** at Our Institute of Orthopaedics and Traumatology , Madras medical college and Rajiv Gandhi Government general hospital, Chennai.

INCLUSION CRITERIA CONSISTS OF

- Age greater than or equal to 20 years ,
- Closed fractures of both bone leg
- Segmental fractures of tibia
- Proximal one third of tibia fracture
- All diaphyseal fracture of tibia
- Ipsilateral femoral fractures
- Stiff knee

EXCLUSION CRITERIA ARE

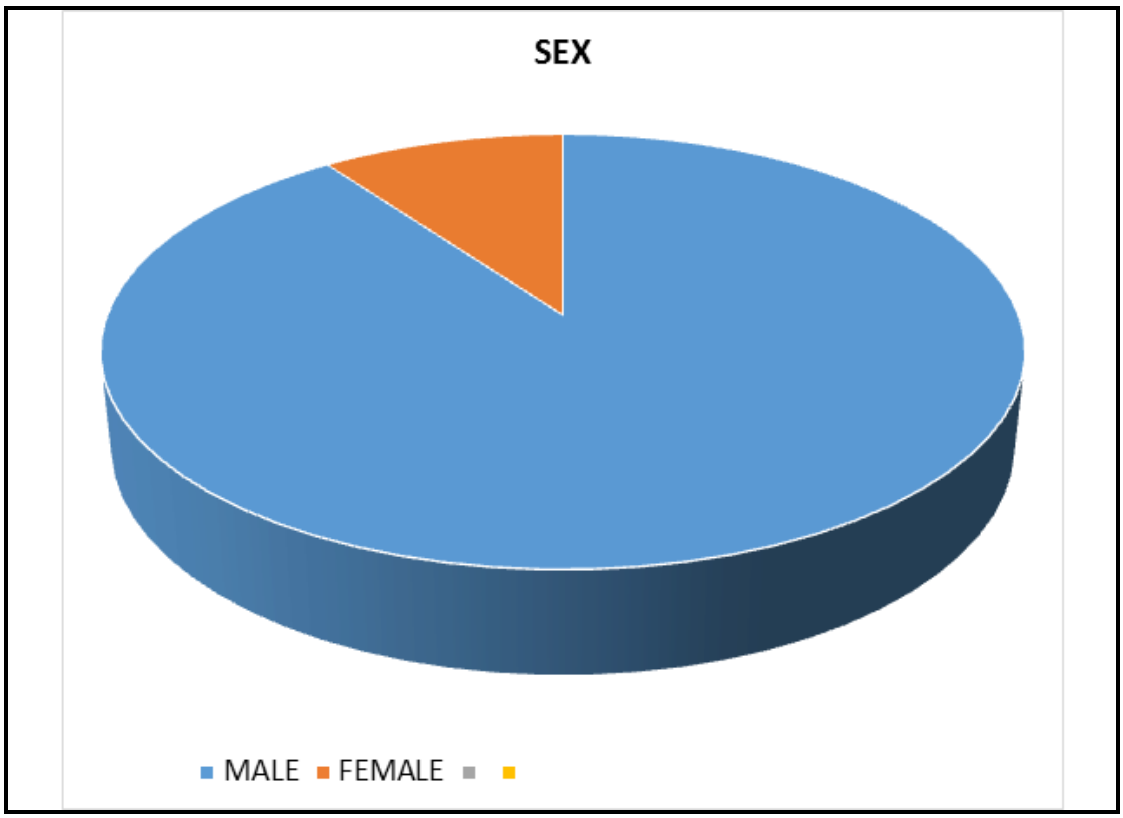
- ❖ Paediatric fractures of tibia
- ❖ Age more than 70 years
- ❖ Associated comorbidities
- ❖ Intra articular extension fracture

STUDY ANALYSIS

In our study there are several parameters are analysed there are

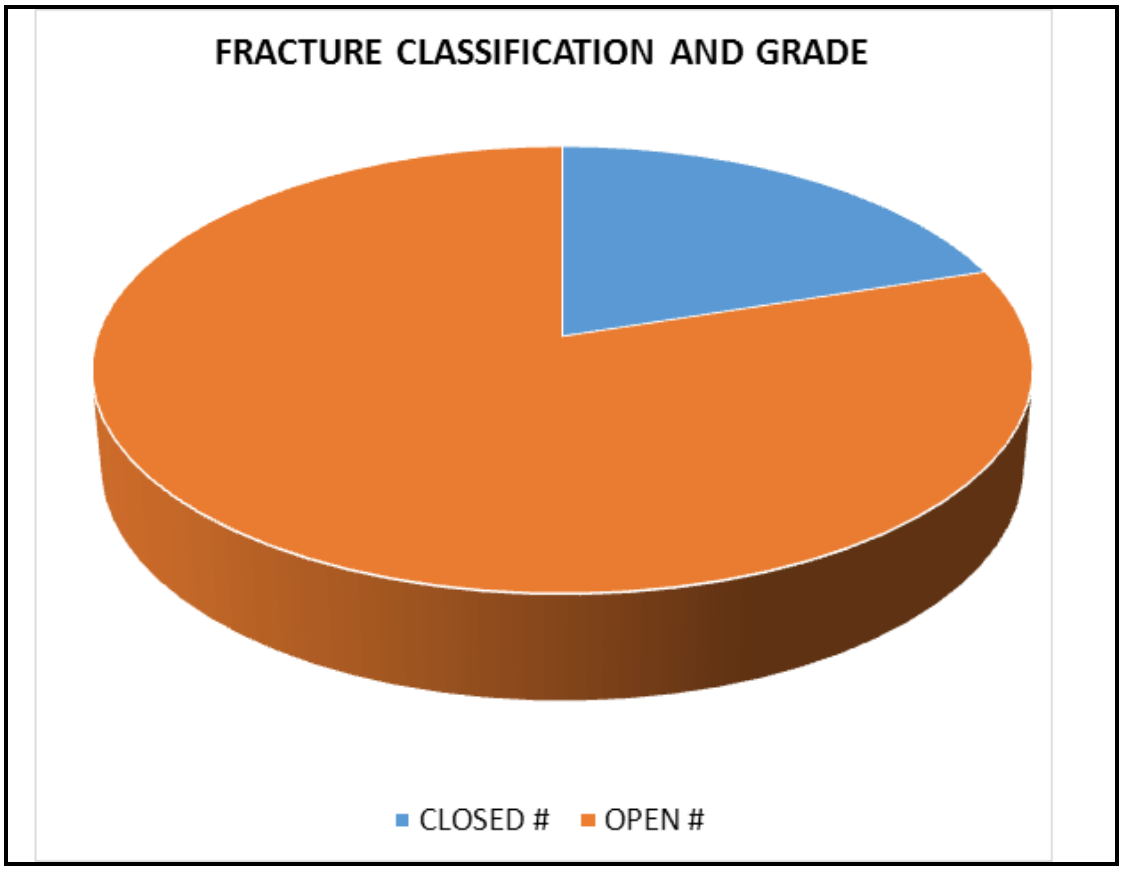
SEX

In our study analysis out of 20 patients 18 patients 90% are males and 2 patients 10% are females



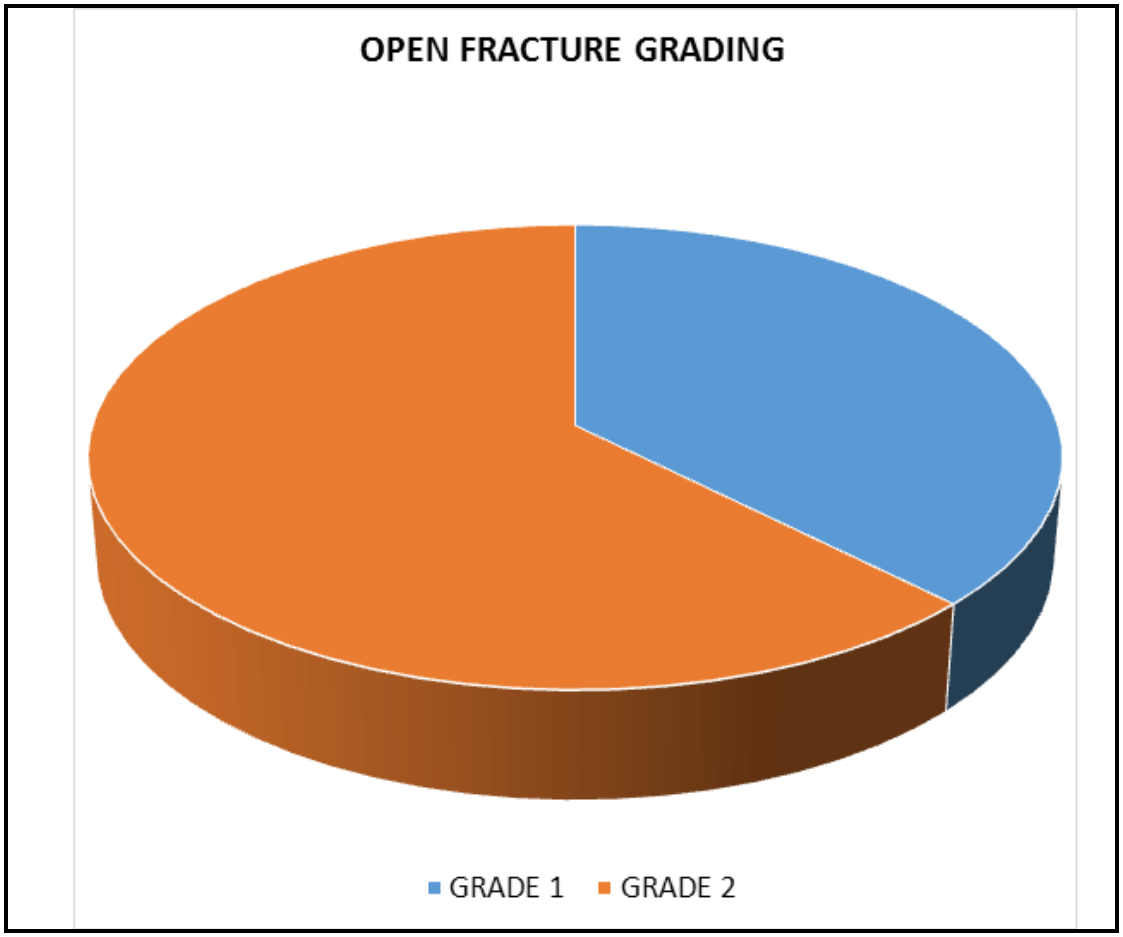
FRACTURE CLASSIFICATION AND GRADE

In our study 4 patients out of 20 patients had closed fractures(20%),the remaining 16 patients had open fractures(80%)



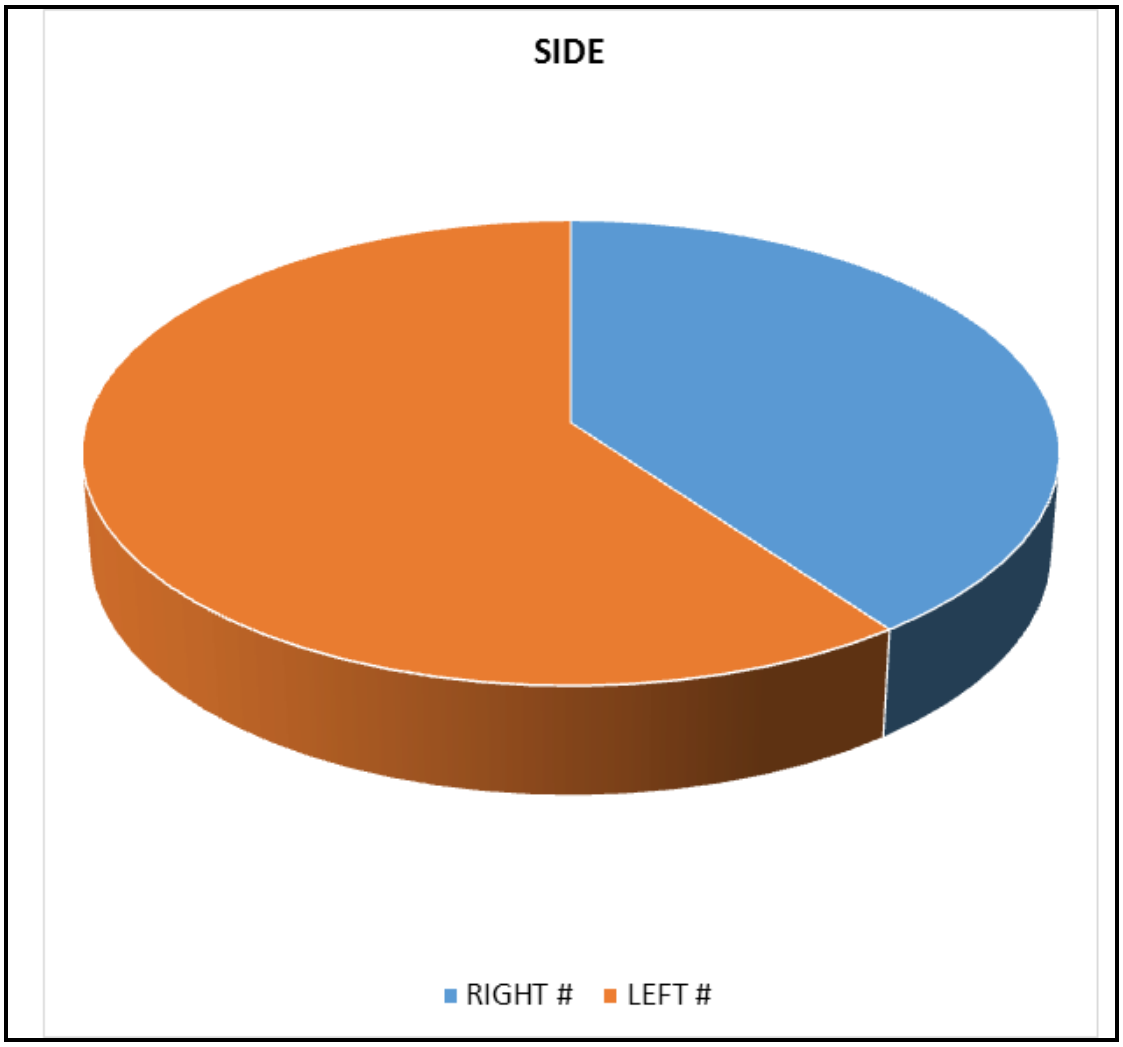
OPEN FRACTURE GRADING

In our study out of 16 patients ,10 patients had grade 2 compound fractures (62.5%),the remaining 6 patients had grade 1 compound fracture (37.5%).



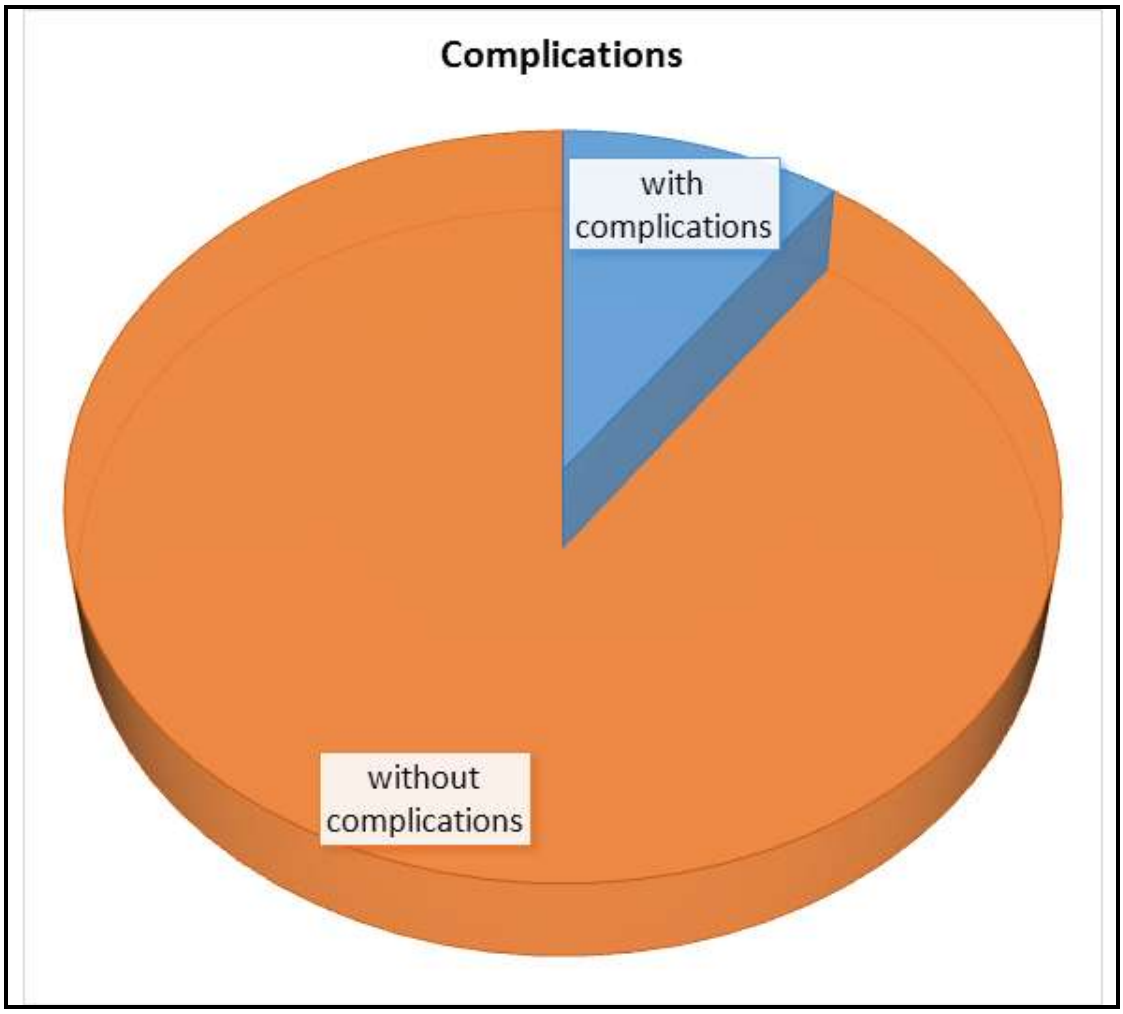
SIDE

In our study analysis out of 20 patients 8 patients are right sided fracture (40%) ,remaining 12 patients are left sided fractures(60%)



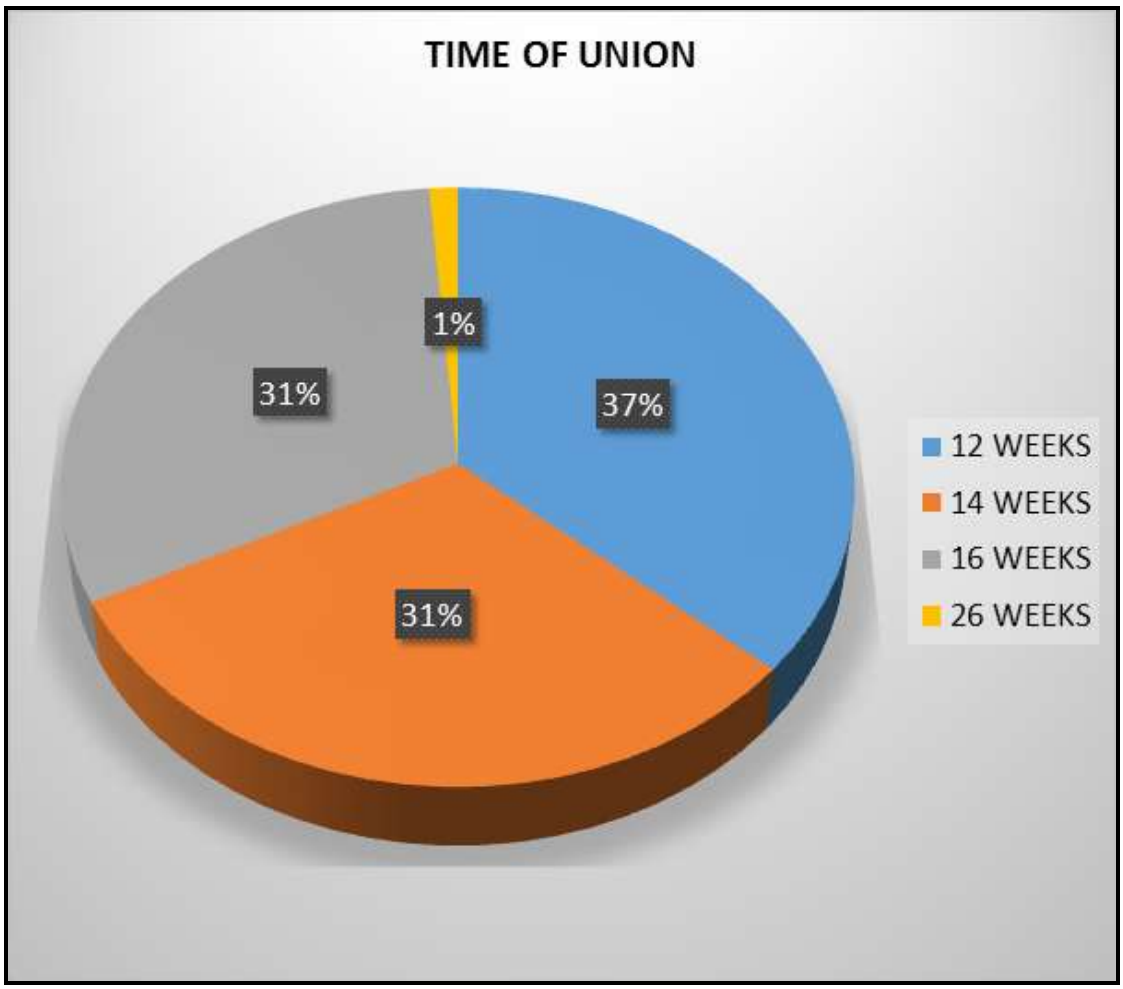
COMPLICATIONS

In our study analysis out of 20 patients, 2 patients (10%)had complications [1-delayed union and 2- infected proximal screw] and 18(90%) got outcome without complications.



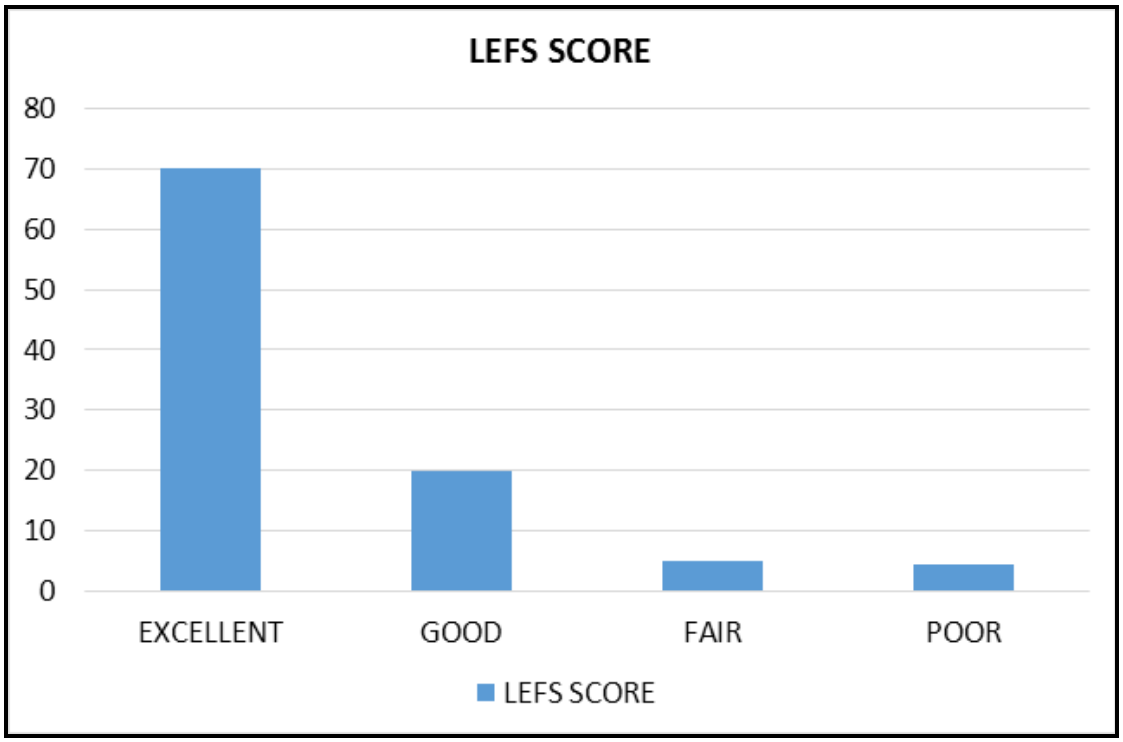
TIME OF UNION

In our study out of 20 patients, 7 (35%) patients had union occurred around 12 weeks 6 (30%)patients had union occurred around 14 weeks 6 (30%)patients had union occurred around 16 weeks 1 (5%) patients had delay union occurred around more than 26 weeks.



LOWER EXTREMITY FUNCTIONAL SCALE

In our study analysis out of 20 patients, 14 (70%)patients had excellent LEFS score, 4 (20%)patients had good LEFS score 1 (5%) patients had fair LEFS score 1 (5%) patients had poor LEFS score.



FUNCTIONAL OUTCOME

In our study ,we selected 20 patients based on inclusion exclusion criteria operated with suprapatellar approach for intramedullary tibial nailing in semi extended position of knee.Satisfactory outcomes and reproducible results can be achieved with intramedullary nail fixation of tibial shaft fracture.

The average operative time of the patient was 75 mins ± 15 mins .The average blood loss was 80 ml ± 20 ml .

During the mean follow up period of 10.5 months.19 patient received clinical and radiographic return visit.The remaining one patient who got difficulty to review at the hospital were followed up by the telephone .

The radiographic examination showed the callus appeared in all patients at average 6-8 weeks after surgery with fracture healing time 14-20 weeks.One patient had delay union more than 28 weeks and one patient had proximal screw site infection .

No patient experienced loosening or breakage of internal fixation and no one complained of knee joint pain and no postoperative anterior knee pain.

No reduction loss and aggravating displacement occurred after surgery.The mean knee and ankle range of movement significantly improved at each follow up.The average lower extremity functional scale score 70,it was excellent.

In my study, there are 20 patients

AVERAGE	SUPRAPATELLAR APPROACH OF TIBIA NAIL IN SEMI EXTENDED POSITION
TIME OF UNION	16 weeks
FOLLOW UP PERIOD	10 months
LOWER EXTREMITY FUNCTIONAL SCALE SCORE	72/80

DISCUSSION

In our study we selected ,20 patients with fracture tibia from my institute .All patients underwent operative procedure in the form of intramedullary interlocking tibial nail through suprapatellar approach in semi extended position of knee.Of the 20 patients treated with suprapatellar approach ,excellent results with good range of movements with excellent lower extremity functional scale score.

The significant advantage of suprapatellar approach was the extension of knee during surgery which was very useful in the treatment of complex metaphyseal and diaphyseal tibia fractures.In the proximal oblique metaphyseal fracture with posterior cortical extension , the suprapatellar technique reduces the risk of posterior cortex perforation by placing the starting point in line with the medullary canal.It also relaxes quadriceps muscle ,preventing malreduction.This technique also helps to reduce Varus and Valgus deformity by using the femoral trochlear groove as a guide to the starting point.This maintains the mechanical axis of the lower extremity .Additionally surgeon convenient assess through the safe zone on the tibial plateau.

A potential criticism of this approach is intraarticular involvement and the potential for patellar or trochlear chondral injury.Althouh this approach transverses the patellofemoral joint , the entry sleeve is in the

place at all times, protecting the chondral surface during reaming.Furthermore ,the sleeve will easily collect the bone debridement that would be rapidly suctioned out.

Patient who received the conventional infrapatellar intramedullary nailing often felt postoperative pain, which was related to surgery method , patellar ligament and infrapatellar nerve injury ,muscle strength changes ,protrusion of inserted objects tail and other factors. Gaines et al also proved that the suprapatellar approach was associated with a lower overall incidence of damage to the intraarticular structures.

In our study there was also no patient suffering from postoperative knee pain at present which could be explained by several reasons,first,the sleeve adjoint tightly to tibial spine and protect patella cartilage from the damage of surgical instruments, followed by less operative time .

CONCLUSION

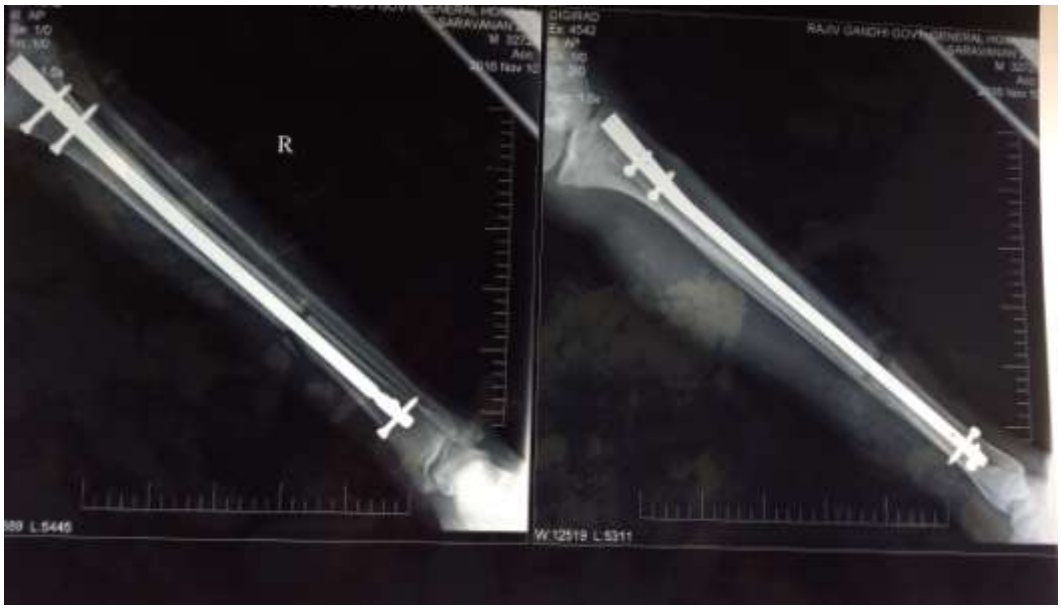
Reamed locked intramedullary nailing remains the standard treatment for displaced tibial shaft fractures. In our study we describe surgical hints in addition to the benefits of suprapatellar approach.A correct starting point remains a crucial part of surgical procedure.Suprapatellar approach of intramedullary tibial nailing in semi extended position of knee offers an alternative to traditional infrapatellar approach.Specific instrumentation with a canula system allows for nail insertion in a safe fashion and minimize the risk of iatrogenic damage to intraarticular structures.The semiextended position of knee facilitate fracture reduction particular in proximal third tibial fracture and all diaphyseal tibial fractures. This approach had excellent outcome for Ipsilateral Femoral Shaft Fractures, Stiff Knee and Proximal 1/3rd of Tibia Fracture. The preliminary data suggested a low rate of post operative anterior knee pain.

CASE ILLUSTRATIONS

CASE-I

Name	:	Mr. Saravanan ,25/M , IP No :109954
Diagnosis	:	Closed isolated fracture of tibia left side
Procedure Done	:	Suprapatellar approach for intramedullary tibial nailing left side
Post OP period	:	Uneventful
Followup Duration	:	12 months
Time of union	:	14 weeks

Preop radiograph image



Two months follow up

Twelve months fol lowup

Functional outcome

CASE 2

Name	:	Mr.Rajkumar, 22/M , IP No:118256
Diagnosis	:	Bilateral closed shaft of femur with fracture both bone leg right side
Procedure	:	Suprapatellar approach for intramedullary tibial nailing right side and open reduction internal fixation interlocking nail of right femur (same sitting)
Post OP period	:	Delayed Weight bearing
Followup Duration	:	11 months
Time of union	:	16 weeks

Pre op images

Immediate postop Xray

Ten months followup

Functional outcome pictures

CASE 3

Name	:	Mr.Senthil Kumar ,35/M ,IP No :8322
Diagnosis	:	Closed fracture both bone leg left side with type2 diabetes mellitus
Procedure	:	Suprapatellar approach for intramedullary tibial nailing left side
Post OP period	:	Uneventful, adequate glycemic status, wound heal well
Followup Duration	:	12 months
Time of union	:	14 weeks

Immediate post op images

Two months follow up

Eleven months follow up

Functional outcome

CASE 4

Name	:	Mr.Arul , 22/M , IP No. 15557
Diagnosis	:	Closed fracture both bone leg right side
Procedure	:	Suprapatellar approach for intramedullary tibial nailing right side
Post OP period	:	Uneventful,
Follow up Duration	:	10 months
Time of union	:	12 weeks

Pre op Xray

Immediate post op X ray

Ten months follow up X ray

Functional outcome images

CASE 5

Name	:	Mr. Veerarhagavan , 58/M ,IP No.9942
Diagnosis	:	Segmental compound fracture both bone leg left side
Procedure	:	Suprapatellar approach for intramedullary tibial nailing left side
Post OP period	:	Uneventful
Follow up Duration	:	12 months
Time of union	:	12 weeks

Pre op Xray imaes

Immediate post op image

Twelve months follow up

Functional outcome images

CASE 6

Name	:	Mr. Subramani , 28/M ,IP No.10342
Diagnosis	:	Closed fracture both bone leg left side
Procedure	:	Suprapatellar approach for intramedullary tibial nailing left side
Post OP period	:	Delay union
Follow up Duration	:	12 months
Time of union	:	More than 26 weeks

Pre op Xray images

Immediate post op Xray

Four months follow up ***Seven month follow up***

Inspite of serial radiographic review fracture site callus occured is delayed ,now we plan for Dynamisation of proximal screw depending upon the patient willingness and general condition of the patient

Functional outcome images

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SUPRAPATELLAR APPROACH FOR TIBIA NAILING
PROFORMA

1. Name:
2. Age/Sex:
3. Address:
4. Phone No:
5. Mode of Injury/Duration:
6. Associated Comorbidities:
7. Diagnosis:
8. Preop X-ray Knee with Leg, Leg with Ankle AP/Lat view:
9. Procedure Done:
10. Post Op Protocol:
11. Postop xray:
12. Postop Functional Score:
13. Radiological Union:
14. Complication:
15. Rehabilitation Protocol:

INSTITUTIONAL ETHICS COMMITTEE
MADRAS MEDICAL COLLEGE, CHENNAI 600 003

EC Reg.No.ECR/270/Inst./TN/2013
Telephone No.044 25305301A
Fax: 011 25363970

CERTIFICATE OF APPROVAL

To
Dr.Sudhakar.R
Post Graduate in M.S. Orthopaedics
Institute of Orthopaedics and Traumatology
Madras Medical College & RGGGH
Chennai 600 003

Dear Dr.Sudhakar.R ,

The Institutional Ethics Committee has considered your request and approved your study titled **"SUPRAPATELLAR APPROACH FOR INTRAMEDULLARY TIBIAL NAILING IN SEMI EXTENDED POSITION OF KNEE-CASE SERIES STUDY " NO. 26122016.**

The following members of Ethics Committee were present in the meeting hold on **14.12.2016** conducted at Madras Medical College, Chennai 3

1.Dr.C.Rajendran, MD.,	:Chairperson
2.Dr.M.K.Muralidharan,MS.,M.Ch.,Dean, MMC,Ch-3	:Deputy Chairperson
3.Prof.Sudha Seshayyan,MD., Vice Principal,MMC,Ch-3	: Member Secretary
4.Prof.B.Vasanthi,MD., Prof.of Pharmacology.,MMC,Ch-3	: Member
5.Prof.A.Rajendran,MS, Prof. of Surgery,MMC,Ch-3	: Member
6.Prof.N.Gopalakrishnan,MD,Director,Inst.of Nephrology,MMC,Ch	: Member
7.Prof.Baby Vasumathi,MD.,Director, Inst. of O & G	: Member
8.Prof.K.Ramadevi,MD.,Director,Inst.of Bio-Che,MMC,Ch-3	: Member
9.Prof.R.Padmavathy, MD, Director,Inst.of Pathology,MMC,Ch-3	: Member
10.Prof.S.Mayilvahanan,MD,Director, Inst. of Int.Med,MMC, Ch-3	: Member
11.Tmt.J.Rajalakshmi, JAO,MMC, Ch-3	: Lay Person
12.Thiru S.Govindasamy, BA.,BL,High Court,Chennai	: Lawyer
13.Tmt.Arnold Saulina, MA.,MSW.,	:Social Scientist

We approve the proposal to be conducted in its presented form.

The Institutional Ethics Committee expects to be informed about the progress of the study and SAE occurring in the course of the study, any changes in the protocol and patients information/informed consent and asks to be provided a copy of the final report.

14.12

Member Secretary – Ethics Committee

MEMBER SECRETARY
INSTITUTIONAL ETHICS COMMITTEE
MADRAS MEDICAL COLLEGE
CHENNAI-600 003

நோயாளியின் ஒப்புதல் படிவம்

ஆராய்ச்சி தலைப்பு : **Suprapatelar Aproach of Intramedullary Tibial Nailingin Semi Extended Position of Knee- Case Series Study**

ஆராய்ச்சி இடம் : **எலும்பியல் மற்றும் முடநீக்கியல் நிறுவனம், ராஜீவ் காந்தி அரசு பொது மருத்துவமனை, சென்னை-600 003.**

நோயாளியின் பெயர் :

வயது/ பாலினம் : உள்நோயாளி எண்:

நான் மேற்கூறிய சிகிச்சை முறையைப் பற்றி முழுவதுமாக அறிந்துகொண்டேன். என்னுடைய சந்தேகங்கள் மற்றும் கேள்விகளுக்கு தெளிவான முறையில் விளக்கங்கள் எடுத்துரைக்கப்பட்டது.

இந்த சிகிச்சையின் மூலம் ஏற்படக்கூடிய நன்மைகளையும் பின்விளைவுகளைப் பற்றியும் அறிந்துகொண்டேன்.

நான் இந்த சிகிச்சைக்கு தானாகவே முன்வந்து ஒப்புக்கொள்கிறேன் மற்றும் எந்நேரமும் சிகிச்சையின்போது எந்தவித விளக்கமும் தெரிவிக்காமல் விலகிக்கொள்ளலாம் என்பதை அறிவேன்.

நான் பரிசோதனையிலிருந்து விலகினாலும் என்னுடைய பரிசோதனை பதிவேடுகளை இதற்கான உயர் அதிகாரிகளின் படிப்பிற்காகவும் மற்றும் ஆராய்ச்சி படிப்பிற்காகவும் பயன்படுத்திக்கொள்ள முழு மனதுடன் சம்மதம் அளிக்கிறேன்.

எனது நோயின் முழு விவரங்களையும் எந்த தடையுமின்றி இந்த ஆராய்ச்சி படிப்பிற்கு பயன்படுத்திக்கொள்ளலாம்.

பங்கேற்பாளர் கையொப்பம்

ஆராய்ச்சியாளர் பெயர்: மரு.இரா.சுதாகர்
MS Ortho Post Graduate

நாள் :
இடம் :

URKUND

Urkund Analysis Result

Analysed Document: Sudhakar_DISSERTATION.pdf (D31763607)
Submitted: 10/27/2017 2:00:00 PM
Submitted By: sudhakarmsortho@gmail.com
Significance: 13 %

Sources included in the report:

ARUL THESIS 2 A.docx (D31564868)
thesis1.pdf (D31421666)
THESIS PLAGIARISM.docx (D30857486)
http://www.orthobullets.com/anatomy/10133/compartments-of-leg

Instances where selected sources appear:

12

Master Chart

S. No	Name	Age	Sex	IP No	Time Interval	Fracture Classification	Associated with	Time of Union	Complication	Followup Duration	LEFS Score	Remarks
1	Saravanan	25	M	109954	30 Days	Gr.I Compound Fracture Lt.		14 Wks	-	12 Months	80/80	
2	Venkatesan	30	M	10722	20 Days	Gr.II Compound Fracture Lt		14 Wks	-	12 Months	70/80	
3	Subramani	28	M	9942	10 Days	Closed Fracture Lt.		> 28 Wks	Delayed Union	12 Months	60/80	Plan for Dynamization of Proximal Screw
4	Govindammal	60	F	110081	50 Days	Gr.I Compound Fracture Lt.	DVT	12 Wks		6 Months	70/80	After 6 Months patient not attend followup
5	Senthil Kumar	35	M	83662	14 Days	Closed Fracture Lt.	DM	12 Wks		12 Months	80/80	
6	Rajkumar	22	M	43852	40 Days	Gr.I Compound Fracture Rt.	B/L SOF Closed Fracture	16 Wks		12 Months	60/80	
7	Pushpalatrha	55	F	99903	30 Days	Gr.II Compound Fracture Lt		14 Wks		12 Months	70/80	
8	Palani	40	M	85623	30 Days	Closed Fracture Rt.		14 Wks		11 Months	70/80	
9	Boopathi	32	M	563215	30 Days	Gr.II Compound Fracture Lt		12 Wks		11 Months	70/80	
10	Prakash	48	M	94831	15 Days	Gr.II Compound Fracture Lt		16 Wks		10 Months	60/80	
11	Prabhu	20	M	10377	25 Days	Gr.I Compound Fracture Rt.		16 Wks		12 Months	80/80	
12	Shankar	25	M	45632	45 Days	Gr.II Compound Fracture Lt		12 Wks		11 Months	70/80	
13	Sadhanantham	52	M	654512	21 Days	Gr.I Compound Fracture Rt.		14 Wks	Proximal Screw Infection	12 Months	70/80	Plan for Proximal Screw Removal
14	Krishnan	40	M	11422	40 Days	Gr.II Compound FractureRt		16 Wks		12 Months	70/80	
15	Mohamed Jafar Khan	54	M	12951	20 Days	Gr.II Compound Fracture Lt		16 Wks		12 Months	70/80	
16	Arul	22	M	15557	14 Days	Closed Fracture Rt.		12 Wks		12 Months	80/80	
17	Raja	28	M	10339	10 Days	Gr.II Compound Fracture Lt		16 Wks		8 Months	70/80	
18	Chandran	46	M	11336	20 Days	Gr.II Compound Fracture Lt		14 Wks		7 Months	70/80	
19	Kithai Dass	40	M	11291	30 Days	Gr.II Compound Fracture Rt		12 Wks		12 Months	80/80	
20	Veera Raghavan	55	M	10229	40 Days	Gr.I Compound Fracture Rt.		12 Wks		12 Months	70/80	